Appendix Q1

Major DOT Regulations and Example of Bill of Lading

The major areas in the DOT regulations that are most relevant for transportation of typical fixed gauges that are shipped as Type A quantities are as follows:

- Table of Hazardous Materials and Special Provisions 49 CFR 172.101, and App. A, Table 2: Hazardous materials table, list of hazardous substances and reportable quantities
- Package Markings 49 CFR 172.300, 49 CFR 172.301, 49 CFR 172.303, 49 CFR 172.304, 49 CFR 172.310, 49 CFR 172.324: General marking requirements for non-bulk packaging, prohibited marking, marking requirements, radioactive material, hazardous substances in non-bulk packaging
- Package Labeling 49 CFR 172.400, 49 CFR 172.401, 49 CFR 172.403, 49 CFR 172.406, 49 CFR 172.407, 49 CFR 172.436, 49 CFR 172.438, 49 CFR 172.440: General labeling requirements, prohibited labeling, radioactive materials, placement of labels, specifications for radioactive labels
- Placarding of Vehicles 49 CFR 172.500, 49 CFR 172.502, 49 CFR 172.504, 49 CFR 172.506, 49 CFR 172.516, 49 CFR 172.519, 49 CFR 172.556: Applicability, prohibited and permissive placarding, general placarding requirements, providing and affixing placards: highway, visibility and display of placards, RADIOACTIVE placard
- Emergency Response Information, Subpart G, 49 CFR 172.600, 49 CFR 172.602, 49 CFR 172.604: Applicability and general requirements, emergency response information, emergency response telephone number
- Training, Subpart H, 49 CFR 172.702, 49 CFR 172.704: Applicability and responsibility for training and testing, training requirements
- Radiation Protection Program for Shippers and Carriers, Subpart I, 49 CFR 172.800, etc.
- Shippers General Requirements for Shipments and Packaging, Subpart I, 49 CFR 173.403, 49 CFR 173.410, 49 CFR 173.412, 49 CFR 173.415, 49 CFR 173.433, 49 CFR 173.435, 49 CFR 173.441, 49 CFR 173.475, 49 CFR 173.476: Definitions, general design requirements, additional design requirements for Type A packages, authorized Type A packages, requirement for determining A₁ and A₂, table of A₁ and A₂ values for radionuclides, radiation level limit, quality control requirements prior to each shipment, approval of special form radioactive materials
- Carriage by Public Highway 49 CFR 177.816, 49 CFR 177.817, 49 CFR 177.834(a), 49 CFR 177.842: Driver training, shipping paper, general requirements (secured against movement), Class 7 (radioactive) material

Note: Type B shipping packages transport quantities of radionuclides greater than Type A allowable quantities. Requirements for Type B packages are in 10 CFR Part 71.

Appendix Q2

Hazard Communications for Class 7 (Radioactive) Materials

Marking Packages (49 CFR 172.300-338)

NOTE: IAEA, ICAO, and IMO may require additional hazard communication information for international shipments This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

Markings Always Required Unless Excepted	Additional Markings Sometimes Required	Optional Markings	
		•	
or freight container are shipped from one consignor to one consignee [see §172.301(d)] Bulk Packages (i.e., net capacity greater than 119 gallons as a receptacle for liquid, or 119 gallons and 882 pounds as a receptacle for solid, or water capacity greater than 1000 lbs, with no consideration of intermediate forms of containment) U.N. identification number, on orange, rectangular panel (see §172.332) – some exceptions exist	 Materials-Based Requirements: If in excess of 110 lbs (50 kg), Gross Weight If non-bulk liquid package, underlined double arrows indicating upright orientation (two opposite sides) [ISO Std 780-1985 marking] If a Hazardous substance in non-bulk package, the letters "RQ" in association with the proper shipping name Package-Based Requirements: The package type if Type A or Type B (½" or greater letters) The specification-required markings [e.g., for Spec. 7A packages: "DOT 7A Type A" and "Radioactive Material" (see §178.350-353)] For approved packages, the certificate ID number(e.g., USA/9166/B(U), USA/9150/B(U)-85,) If Type B, the trefoil (radiation) symbol per Part 172 App. B [size: outer radius ≥ 20 mm (0.8 in)] For NRC certified packages, the model number, gross weight, and package ID number (10 CFR 71.85) Administrative-Based Requirements: If a DOT exemption is being used, "DOT-E" followed by the exemption number If an export shipment, "USA" in conjunction with the specification markings or certificate markings 	 "IP-1," "IP-2," or "IP-3" on industrial packaging is recommended Both the name and address of consignor and consignee are recommended Other markings (e.g., advertising) are permitted, but must be sufficiently away from required markings and labeling 	

Some Special Considerations/Exceptions for Marking Requirements

- Marking is required to be: (1) durable, (2) printed on a package, label, tag, or sign, (3) unobscured by labels or attachments, (4) isolated from other marks, and (5) be representative of the hazmat contents of the package
- Limited Quantity (§173.421) packages and Articles Containing Natural Uranium and Thorium (§173.426) must bear the marking "radioactive" on the outside of the inner package or the outer package itself, and are excepted from other marking. The excepted packages shipped under UN 2910 must also have the accompanying statement that is required by §173.422.
- Empty (§173.428) and Radioactive Instrument and Article (§173.424) packages are excepted from marking
- Shipment of LSA or SCO required by §173.427 to be consigned as exclusive use are excepted from marking except that the exterior of each nonbulk package must be marked "Radioactive-LSA" or "Radioactive-SCO," as appropriate. Examples of this category are domestic, strong-tight containers with less than an A₂ quantity, and domestic NRC certified LSA/SCO packages using 10 CFR 71.52.
- For bulk packages, marking may be required on more than one side of the package (see 49 CFR 172.302(a))

Hazard Communications for Class 7 (Radioactive) Materials **DOT Shipping Papers (49 CFR 172.200-205)**

NOTE: IAEA, ICAO, and IMO may require additional hazard communication information for international shipments This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

Entries Always Required Unless Excepted Additional Entries Sometimes Required

Optional Entries

The basic description, In sequence: Proper Shipping Name,

Hazard Class (7),

U.N. Identification Number

- 24 hour **emergency response** telephone number
- Name of **shipper**
- Proper page numbering (Page 1 of 4)
- Except for empty and bulk packages, the total quantity (mass, or volume for liquid), in appropriate units (lbs, mL....)
- If not special form, chemical and physical form
- The name of each radionuclide (95% rule) and total package activity. The activity must be in SI units (e.g., Bq, TBq), or both SI units and customary units (e.g., Ci, mCi). However, for domestic shipments, the activity may be expressed in terms of customary units only, until 4/1/97.
- For each labeled package:
 - The category of label used;
 - The **transport index** of each package with a Yellow-II or Yellow-III label
- Shipper's **certification** (not required of private carriers)

Materials-Based Requirements:

- If hazardous substance, "RQ" as part of the basic description
- The LSA or SCO group (e.g., LSA-II)
- "Highway Route Controlled Quantity" as part of the basic description, if HRCQ
- Fissile material information (e.g., "Fissile Exempt," controlled shipment statement [see §172.203(d)(7)])
- If the material is considered hazardous waste and the word waste does not appear in the shipping name, then "waste" must precede the shipping name (e.g., Waste Radioactive Material, nos, UN2982)
- "Radioactive Material" if not in proper shipping name

Package-Based Requirements:

- Package identification for DOT Type B or NRC certified packages
- IAEA CoC ID number for export shipments or shipments using foreignmade packaging (see §173.473)

Administrative-Based Requirements:

- "Exclusive Use-Shipment"
- Instructions for maintenance of exclusive use-shipment controls for LSA/SCO strong-tight or NRC certified LSA (§ 173.427)
- If a DOT exemption is being used, "DOT-E" followed by the exemption number

- The type of packaging (e.g., Type A, Type B, IP-1,)
- The Technical/chemical name may be in included (if listed in §172.203(k), in parentheses between the proper shipping name and hazard class; otherwise inserted in parenthesis after the basic description)
- Other information is permitted (e.g., functional description of the product), provided it does not confuse or detract from the proper shipping name or other required information
- For fissile radionuclides, except Pu-238, Pu-239, and Pu-241, the weight in grams or kilograms may be used in place of activity units. For Pu-238, Pu-239, and Pu-241, the weight in grams or kilograms may optionally be entered in addition to activity units [see § 172.203(d)(4)]
- Emergency response hazards and guidance information (§§ 172.600-604) may be entered on the shipping papers, or may be carried with the shipping papers [§ 172.602(b)]

Some Special Considerations/Exceptions for Shipping Paper Requirements

- Shipments of Radioactive Material, excepted packages, under UN2910 (e.g., Limited Quantity, Empty packages, and Radioactive Instrument and Article), are excepted from shipping papers. For limited quantities (§173.421), this is only true if the limited quantity is not a hazardous substance (RQ) or hazardous waste (40 CFR 262)
- Shipping papers must be in the pocket on the left door, or readily visible to person entering driver's compartment and within arm's reach of the driver
- For shipments of multiple cargo types, any HAZMAT entries must appear as the first entries on the shipping papers, be designated by an "X" (or "RQ") in the hazardous material column, or be highlighted in a contrasting color

NRC Contacts: John Cook, (301) 415-8521 Earl Easton, (301) 415-8520

Hazard Communications for Class 7 (Radioactive) Materials Labeling Packages (49 CFR 172.400-450)

NOTE: IAEA, ICAO, and IMO may require additional hazard communication information for international shipments This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

Placement of Radioactive Labels

- Labeling is required to be: (1) placed near the required marking of the proper shipping name, (2) printed or affixed to the package surface (not the bottom), (3) in contrast with its background, (4) unobscured by markings or attachments, (5) within color, design, and size tolerance, and (6) representative of the HAZMAT contents of the package
- For labeling of radioactive materials packages, two labels are required on opposite sides excluding the bottom

Determination of Required Label					
Size: Sides: ≥ 100 mm (3.9 in.) Border: 5-6.3 mm (0.2-0.25 in.)	49 CFR 172.436	49 CFR 172.438	49 CFR 172.440	49 CFR 172.450	
Label	WHITE-I	YELLOW-II	YELLOW-III	EMPTY LABEL	
Required when:	Surface radiation level < 0.005 mSv/hr (0.5 mrem/hr)	.005 mSv/hr (0.5 mrem/hr) < surface radiation level ≤ 0.5 mSv/hr (50 mrem/hr)	0.5 mSv/hr (50 mrem/hr) < surface radiation level ≤ 2 mSv/hr (200 mrem/h) [Note: 10 mSv/hr (1000 mrem/hr) for exclusive-use closed vehicle (§173.441(b)]	The EMPTY label is required for shipments of empty Class 7 (radioactive) packages made pursuant to §173.428. It must cover any previous labels, or they must be removed or obliterated.	
<u>Or:</u>		TI ≤ 1 [1 meter dose rate < 0.01 mSv/hr (1 mrem/hr)]	TI ≤ 10 [1 meter dose rate < 0.1 mSv/hr (10 mrem/hr)] [Note: There is no package TI limit for exclusive-use]		
Notes:	 Any package containing a Highway Route Controlled Quantity (HRCQ) must bear YELLOW-III label Although radiation level transport indices (TIs) are shown above, for fissile material, the TI is typically determined on the basis of criticality control 				

Content on Radioactive Labels

- RADIOACTIVE Label must contain (entered using a durable, weather-resistant means):
- (1) The radionuclides in the package (with consideration of available space). Symbols (e.g., Co-60) are acceptable
- (2) The activity in SI units (e.g., Bq, TBq), or both SI units with customary units (e.g., Ci, mCi) in parenthesis. However, for domestic shipments, the activity *may* be expressed in terms of customary units only, until 4/1/97.
- (3) The Transport Index (TI) in the supplied box. The TI is entered only on YELLOW-II and YELLOW-III labels

Some Special Considerations/Exceptions for Labeling Requirements

- For materials meeting the definition of another hazard class, labels for each secondary hazard class need to be affixed to the package. The subsidiary label *may* not be required on opposite sides, and must not display the hazard class number
- Radioactive Material, excepted packages, under UN2910 (e.g., Limited Quantity, Empty packages, and Radioactive Instrument and Article), are excepted from labeling. However, if the excepted quantity meets the definition for another hazard class, it is re-classed for that hazard. Hazard communication requirements for the other class are required
- Labeling exceptions exist for shipment of LSA or SCO required by § 173.427 to be consigned as exclusive use
- The "Cargo Aircraft Only" label is typically required for radioactive materials packages shipped by air [§ 172.402(c)]

Hazard Communications for Class 7 (Radioactive) Materials Placarding Vehicles (49 CFR 172.500-560)

NOTE: IAEA, ICAO, and IMO may require additional hazard communication information for international shipments This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

Visibility and Display of Radioactive Placard

- Placards are required to be displayed:
- on four sides of the vehicle
- visible from the direction they face, (for the front side of trucks, tractor-front, trailer, or both are authorized)
- clear of appurtenances and devices (e.g., ladders, pipes, tarpaulins)
- at least 3 inches from any markings (such as advertisements) which may reduce placard's effectiveness
- upright and on-point such that the words read horizontally
- · in contrast with the background, or have a lined-border which contrasts with the background
- such that dirt or water from the transport vehicle's wheels will not strike them
- securely attached or affixed to the vehicle, or in a holder.
- Placard must be maintained by carrier to keep color, legibility, and visibility.

Conditions Requiring Placarding

- Placards are required for any vehicle containing package with a RADIOACTIVE Yellow-III label
- Placards are required for shipment of LSA or SCO required by §173.427 to be consigned as exclusive use. Examples of this category are domestic, strong-tight containers with less than an A₂ quantity, and domestic NRC certified LSA/SCO packages using 10 CFR 71.52. Also, for bulk packages of these materials, the orange panel *marking* with the UN Identification number is not required.
- Placards are required any vehicle containing package with a Highway Route Controlled Quantity (**HRCQ**). In this case, the placard must be placed in a square background as shown below (see §173.507(a))

Radioactive Placard

Size Specs:

Sides: \geq 273 mm (10.8 in.)

Solid line Inner border: About 12.7 mm (0.5 in.) from edges

Lettering: $\geq 41 \text{ mm } (1.6 \text{ in.})$

Square for HRCQ: 387mm (15.25 in.)

outside length by 25.4 mm (1 in.) thick



49 CFR 172.556

RADIOACTIVE PLACARD (Domestic)

Base of yellow solid area: $29 \pm 5 \text{ mm} (1.1 \pm 0.2 \text{ in.})$ above horizontal centerline

RADIOACTIVE PLACARD
(International)

IAEA SS 6 (1985) paras. 443-444

RADIOACTIVE 7

RADIOACTIVE 7

See 49 CFR 172.527 AND 556

RADIOACTIVE PLACARD FOR HIGHWAY ROUTE CONTROLLED QUANTITY

(either domestic or international placard could be in middle)

Some Special Considerations/Exceptions for Placarding Requirements

- Domestically, substitution of the UN ID number for the word "RADIOACTIVE" on the placard is prohibited for Class 7 materials. However, some import shipments may have this substitution in accordance with international regulations.
- Bulk packages require the orange, rectangular panel marking containing the UN ID number, which must be placed adjacent to the placard (see §172.332) [NOTE: except for LSA/ SCO exclusive use under §173.427, as above]
- If placarding for more than one hazard class, subsidiary placards must not display the hazard class number. Uranium Hexaflouride (UF₆) shipments \geq 454 kg (1001 lbs) require both RADIOACTIVE and CORROSIVE (Class 8) placarding
- For shipments of radiography cameras in convenience overpacks, if the overpack does not require a RADIOACTIVE YELLOW III label, vehicle placarding is not required (regardless of the label which must be placed on the camera)

Minimum Required Packaging For Class 7 (Radioactive) Materials This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials				
Quantity: < 70 Bq/g (< 0.002 :		A ₁ /A ₂ value (3.421)	, = ,	shielded (§173.427)
Non-LSA/SCO:	Excepted	Туре А	Type B ³	
Domestic or International LSA/SCO: LSA-I solid, (liquid) ¹ SCO-I	Excepted	IP-I		Type B ³
LSA-I Liquid LSA-II Solid, (liquid or gas) ¹ (LSA-III) ¹ SCO-II		IP-II		Type B ³
LSA-II Liquid or Gas LSA-III		IP-III		Type B ³
Domestic (only) LSA/SCO: LSA-I, II, III; SCO-I, II	Excepted	Strong-tight ²		Type B ³ NRC Type A LSA ^{3,4}

- For entries in parentheses, exclusive use is required for shipment in an IP (e.g., shipment of LSA-I liquid in an
- 1. IP-I packaging would require exclusive use consignment)
- 2. Exclusive use required for strong-tight container shipments made pursuant to §173.427(b)(2)
- 3. Subject to conditions in Certificate, if NRC package
- 4. Exclusive use required, see §173.427(b)(4). Use of these packages expires on 4/1/99 (10 CFR 71.52)

Package and Vehicle Radiation Level Limits (49 CFR 173.441) ^A This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials				
Transport Vehicle Use: Non-Exclusive Exclusive				
Transport Vehicle Type:	Open or Closed	Open (flat-bed)	Open w/Enclosure B	Closed
Package (or freight container) Lin	nits:			
External Surface	2 mSv/hr (200 mrem/hr)	2 mSv/hr (200 mrem/hr)	10 mSv/hr (1000 mrem/hr)	10 mSv/hr (1000 mrem/hr)
Transport Index (TI) ^C	10	no limit		
Roadway or Railway Vehicle (or	freight container	:) Limits:		
Any point on the outer surface		N/A	N/A	2 mSv/hr (200 mrem/hr)
Vertical planes projected from outer edges	N/A	2 mSv/hr (200 mrem/hr)	2 mSv/hr (200 mrem/hr)	N/A
Top of		load: (200 mrem/hr)	enclosure: 2 mSv/hr (200 mrem/hr)	vehicle: 2 mSv/hr (200 mrem/hr)
2 meters from		vertical planes: 0.1 mSv/hr (10 mrem/hr)	vertical planes: 0.1 mSv/hr (10 mrem/hr)	outer lateral surfaces: 0.1 mSv/hr (10 mrem/hr)
Underside		2 mSv/hr (200 mrem/hr)		
Occupied position		0.02 mSv/hr (2 mrem/hr) ^E		
Sum of package TI's	n of package TI's 50 no limit ^F			

- A. The limits in this table do not apply to excepted packages see 49 CFR 173.421-426
- B. Securely attached (to vehicle), access-limiting enclosure; package personnel barriers are considered as enclosures
- C. For nonfissile radioactive materials packages, the dimensionless number equivalent to maximum radiation level at 1 m (3.3 feet) from the exterior package surface, in millirem/hour
- D. No dose limit is specified, but separation distances apply to Radioactive Yellow-II or Radioactive Yellow-III labeled packages
- E. Does not apply to private carrier wearing dosimetry if under radiation protection program satisfying 10 CFR 20

F. Some fissile shipments may have combined conveyance TI limit of 100 - see 10 CFR 71.59 and 49 CFR 173.457

Package and Vehicle Contamination Limits (49 CFR 173.443)

This table must not be used as a substitute for the DOT and NRC regulations on the transportation of radioactive materials

NOTE: All values for contamination in DOT rules are to be averaged over each 300 cm²

Sufficient measurements must be taken in the appropriate locations to yield representative assessments

means the sum of beta emitters, gamma emitters, and low-toxicity alpha emitters

means the sum of all other alpha emitters (i.e., other than low-toxicity alpha emitters)

The Basic Contamination Limits for All Packages:

49 CFR 173.443(a), Table 11

reasonably achievable (ALARA)

General Requirement: Non-fixed (removable) contamination must be kept aslow as

 $\&(: 0.4 \text{ Bq/cm}^2 = 40 \text{ Bq/100 cm}^2 = 1 \times 10^{-5} : \text{Ci/cm}^2 = 2200 \text{ dpm/100 cm}^2$ \forall : 0.04 Bq/cm² = 4 Bq/100 cm² = 1x10⁻⁶ :Ci/cm² = 220 dpm/100 cm²

The following exceptions and deviations from the above basic limits exist:

	Regulation 49 CFR §§	Applicable Location and Conditions Which must Be Met:
times the basic limits	173.443(b) and 173.443(c) Also see 177.843 (highway)	On any external surface of a package in an exclusive use shipment , during transport including end of transport. Conditions include: (1) Contamination levels at beginning of transport must be below the basic limits. (2) Vehicle must not be returned to service until radiation level is shown to be ≤ 0.005 mSv/hr (0.5 mrem/hr) at any accessible surface, and there is no significant removable (non-fixed) contamination.
10 times the basic limits	173.443(d) Also see 177.843 (highway)	On any external surface of a package, at the beginning or end of transport, if a closed transport vehicle is used, solely for transporting radioactive materials packages. Conditions include: (1) A survey of the interior surfaces of the empty vehicle must show that the radiation level at any point does not exceed 0.1 mSv/hr (10 mrem/hr) at the surface, or 0.02 mSv/hr (2 mrem/hr) at 1 meter (3.3 ft). (2) Exterior of vehicle must be conspicuously stenciled, "For Radioactive Materials Use Only" in letters at least 76 mm (3 inches) high, on both sides. (3) Vehicle must be kept closed except when loading and unloading.
100 times the basic limits	173.428	 Internal contamination limit for excepted package-empty packaging, Class 7 (Radioactive) Material, shipped in accordance with 49 CFR 173.428. Conditions include: (1) The basic contamination limits (above) apply to external surfaces of package. (2) Radiation level must be ≤ 0.005 mSv/hr (0.5 mrem/hr) at any external surface. (3) Notice in §173.422(a)(4) must accompany shipment. (4) Package is in unimpaired condition & securely closed to prevent leakage. (5) Labels are removed, obliterated, or covered, and the "empty" label (§172.450) is affixed to the package.

In addition, after any incident involving spillage, breakage, or suspected contamination, the modal-specific DOT regulations (§177.861(a), highway; §174.750(a), railway; and §175.700(b), air) specify that vehicles, buildings, areas, or equipment have "no significant removable surface contamination," before being returned to service or routinely occupied. The carrier must also notify offeror at the earliest practicable moment after incident.

Appendix Q-3 Example of a Bill of Lading

STRAIGHT BILL OF LADING Appendix P ORIGINAL-NOT NEGOTIABLE Page 1 of 1 ABC Bottling, Inc. Milwaukee Plant ABC Bottling Chicago Plant Liberty Place Admiral Avenue Milwaukee, Wisconsin 38023 Zer Come 35011 Chicago, Illinois No. of Units Contains Type HM Radioactive material, special form, RQ n.o.s. 7 UN 2974 55.5 GBq 55.5 GBq (1.5 C1) Cs-137 (1.5 Ci) RADIOACTIVE - YELLOW II TI = 0.4 ** USDOT 7A TYPE A Emergency Response Telephone No.: 1-800-000-0000 24 hr/d)** SUBSTITUTE APPROPRIATE INFORMATION FOR YOUR GAUGE AND SHIPMENT COD TO: PLACARDS TENDERED:YES NO COD John Jones STYLE PAS LABELMASTER, Div. of American Labelmark Co., Chicago, 8, 80848 3129-78-0800